

IT IS CLAIMED:

5 1. A communication device for communicating data through a data channel, the communication device comprising:

a. a data transformer operably coupled with the data channel, the data transformer manipulating the data between data bits, a data bit vector, and a transmission symbol, the data bit vector having a selectable predetermined integer number of data bits, the transmission symbol containing a selectable integer number of the data bit vectors; and

10 b. a controller operably coupled with the data transformer, the data transformer being responsive thereto, the controller adaptively selecting the selectable predetermined integer number of data bits, and the selectable integer number of data bit vectors to communicate the data through the data channel at a predetermined data bit rate in response to a data channel condition.

20 2. The communication device of claim 1, wherein the transmission symbol is comprised of one data bit vector having one of a first predetermined integer number of data bits and a second predetermined integer number of data bits represented therein.

30 3. The communication device of claim 1, wherein the transmission symbol is comprised of a selectable integer plurality of data bit vectors, each of the selectable integer plurality of data bit vectors having one of a first predetermined integer number of data bits and a second predetermined integer number of data bits represented therein.

35 4. The communication device of claim 3 wherein the data transformer, responsive to the controller, reversibly groups ones

of the first predetermined integer number of data bits into  
selected ones of the selectable integer plurality of data bit  
5 vectors and ones of the second predetermined integer number of  
data bits into selected others of the selectable integer  
plurality of data bit vectors in the response to the data channel  
condition, the selectable integer plurality of data bit vectors  
forming at least one data symbol corresponding to a predetermined  
10 pattern being representative of a preselected signal  
constellation.

5. The communication device of claim 4 wherein the data  
transformer selects successive ones of a plurality of data  
15 symbols according to one of a preselected coding method and an  
unencoded method, in the response to the controller, the  
controller being responsive to the data channel condition.

6. The communication device of claim 5 wherein the data  
20 transformer dynamically selects a predetermined correlation  
between successive ones of the plurality of data symbols in the  
response to the controller, the controller being responsive to  
the data channel condition.

7. The communication device of claim 5 wherein the data  
25 transformer continuously selects a predetermined correlation  
between successive ones of the plurality of data symbols in the  
response to the controller, the controller being responsive to  
the data channel condition.

8. The communication device of claim 5 wherein the data  
transformer selects a predetermined correlation between  
successive ones of a plurality of transmission symbols in the  
response to the channel condition, according to a preselected  
35 coding method.

9. The communication device of claim 5, wherein the preselected coding method is constellation-multiplexed coding.

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10. The communication device of claim 8, wherein the preselected coding method is constellation-multiplexed coding.

11. The communication device of claim 1, wherein the data channel condition comprises at least one of received power, signal-to-noise ratio, and an input from a master control.

12. The communication device of claim 1, wherein the controller is responsive to the data channel condition in a preselected domain.

13. The communication device of claim 12 wherein the data channel condition comprises at least one of received power, signal-to-noise ratio, and a control master signal.

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14. The communication device of claim 12, wherein the preselected domain comprises one of a time domain and a frequency domain.

15. The communication device of claim 13, wherein the preselected domain comprises one of a time domain and a frequency domain.

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16. The communication device of claim 13, wherein the signal-to-noise ratio comprises one of transmitted power, channel attenuation, noise, and interference.

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17. The communication device of claim 1, wherein the predetermined data bit rate is at least one of a non-power of two and a non-integer.

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18. The communication device of claim 17, wherein the  
transmission symbol is representable by a plurality of symbol  
5 constellations.

19. The communication device of claim 8, wherein the  
communication device is a transmitter, the data transformer  
imparts the predetermined correlation between the successive ones  
10 of the plurality of data symbols, the predetermined data bit rate  
is at least one of a non-power of two and a non-integer, the  
transmission symbol is representable by a plurality of symbol  
constellations, and the preselected coding method is  
constellation-multiplexed coding.

20. The communication device of claim 19, wherein the data  
transformer further comprises:

a. a bit parser grouping ones of the first  
predetermined integer number of data bits into selected ones of  
20 the selectable integer plurality of data bit vectors and ones of  
the second predetermined integer number of data bits into  
selected others of the selectable integer plurality of data bit  
vectors, the bit parser being governed by the controller; and

b. a constellation mapper mapping the at least one  
25 data symbol into the transmission symbol, the constellation  
mapper mapping in response to the controller, the controller  
being responsive to the data channel condition.

21. The communication device of claim 20, further  
30 comprising an encoder operably interposed between the bit parser  
and the constellation mapper, the encoder encoding, in the  
response to the controller, the at least one data symbol into the  
transmission symbol and imparting the predetermined correlation  
thereupon, the controller being responsive to the data channel  
35 condition.

22. The communication device of claim 21 wherein the encoder is a convolutional encoder.

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23. The communication device of claim 20 further comprising a bit buffer operably connected with the bit parser and the constellation mapper for buffering a selectable group of data symbols.

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24. The communication device of claim 23, further comprising an encoder operably interposed between the bit buffer and the constellation mapper, the encoder encoding, in the response to the controller, the selectable group of data symbols into the transmission symbol and imparting the predetermined correlation thereupon, the controller being responsive to the data channel condition.

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25. The communication device of claim 24 wherein the encoder is a convolutional encoder.

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26. The communication device of claim 8, wherein the communication device is a receiver, the transmission symbol is representable by a plurality of symbol constellations, the data transformer detects the predetermined correlation between the successive ones of the plurality of transmission symbols and extracts the selectable predetermined integer number of data bits thereby, the predetermined data bit rate is at least one of a non-power of two and a non-integer, and the preselected coding method is constellation-multiplexed coding.

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27. The communication device of claim 26, wherein a received signal includes a transmission symbol and channel noise imposed thereupon, and the data transformer further comprises:

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a. a noise estimator, operably connected with the data channel and governed by the controller, estimating a noise metric associated with the transmission symbol; and

b. a sequence estimator, operably connected with the noise estimator and governed by the controller, detecting the predetermined correlation between the transmission symbols and the selectable predetermined integer number of data bits, and using the noise metric to filter the channel noise from the received signal, extracting the transmission symbol thereby.

28. The communication device of claim 27, wherein the sequence estimator comprises a maximum likelihood sequence estimator.

29. The communication device of claim 28, wherein the maximum likelihood sequence estimator comprises a Viterbi decoder.

30. The communication device of claim 28, wherein the data transformer further comprises a constellation demapper for demapping the transmission symbols into the selected number of data bits, the demapper being operably connected with the maximum likelihood sequence estimator and governed by the controller.

31. The communication device of claim 26, wherein the received signal is a modulated received signal, and wherein the data transformer further comprises a demodulator operably connected with the data channel, the noise estimator, and the sequence estimator, and governed by the controller, the demodulator restoring at least a portion of the transmission symbols from the modulated received signal.

32. The communication device of claim 27 wherein the  
sequence estimator employs soft-decision decoding to detect the  
5 predetermined correlation.

33. The communication device of claim 32, wherein the  
received signal has a trellis encoding superimposed thereupon,  
and the soft-decision decoding includes finding a path through  
10 the trellis encoding with a minimum-weighted-squared-Euclidean  
distance to the transmission symbol from the received signal.

34. The communication device of claim 31, wherein the  
demodulator further performing a correlative-level decoding.  
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35. The communication device of claim 34, wherein the  
correlative-level decoding includes a partial-response decoding.

36. The communication device of claim 5 wherein the data  
transformer dynamically selects successive ones of the plurality  
of data symbols in the response to the controller, the controller  
20 being responsive to the channel condition.

37. The communication device of claim 5 wherein the data  
transformer continuously selects successive ones of the plurality  
of data symbols in the response to the controller, the controller  
25 being responsive to the channel condition.

38. The communication device of claim 5 wherein the data  
transformer selects successive ones of the plurality of data  
symbols in the response to the data channel condition, according  
30 to a preselected coding method.

39. The communication device of claim 38, wherein the  
preselected coding method is constellation-multiplexed coding.  
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40. The communication device of claim 38, wherein the communication device is a receiver, the transmission symbol is representable by a plurality of symbol constellations, the data transformer detects the successive ones of the plurality of data symbols and extracts the selectable predetermined integer number of data bits thereby, the predetermined data bit rate is at least one of a power-of-two, a non-power of two, and a non-integer, and the preselected coding method is constellation-multiplexed coding.

41. The communication device of claim 40, wherein a received signal includes a transmission symbol and channel noise imposed thereupon, and the data transformer further comprises:

a. a noise estimator, operably connected with the data channel and governed by the controller, for estimating a noise metric associated with the transmission symbol; and

b. a sequence estimator, operably connected with the noise estimator and governed by the controller, detecting the received symbols, and the selectable predetermined integer number of data bits thereby, and using the noise metric to filter the channel noise from the received signal, extracting the transmission symbol thereby.

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42. The communication device of claim 41 wherein the sequence estimator employs soft-decision decoding.

43. The communication device of claim 42, wherein the demodulator further performing a correlative-level decoding.

44. The communication device of claim 43, wherein the correlative-level decoding includes a partial-response decoding.

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45. The communication device of claim 14, wherein the preselected domain comprises time domain and frequency domain;  
5 and wherein the transmission symbol is modulated using an orthogonal frequency division multiplexing technique.

46. The communication device of claim 15, wherein the preselected domain comprises time domain and frequency domain;  
10 and wherein the transmission symbol is modulated using an orthogonal frequency division multiplexing technique.

47. A communication device, comprising:

a. a variable bit rate data to symbol transformer, the  
15 transformer adaptively selecting a data vector sized to have a selectable predetermined integer number of data bits therein, and producing a predetermined data bit rate of at least one of a non-power of two and a non-integer; and

b. a controller for selecting the predetermined data bit  
20 rate in response to a data channel condition.

48. A data communication method, comprising the steps of:

a. sensing a data channel condition;  
b. determining a desired variable bit-per-symbol  
25 transmission rate responsive to the condition;

c. adaptively transforming data reversibly from data bits to symbols, the transforming including:

(1) forming ones of a first selectable predetermined integer number of data bits into selected ones of a selectable  
30 integer plurality of data bit vectors,

(2) forming ones of a second selectable predetermined integer number of data bits into selected others of the selectable integer plurality of data bit vectors, and

(3) forming the symbols from the selectable integer  
35 plurality of data bit vectors; and

d. communicating the symbols at the desired variable bit-per-symbol rate, the desired variable bit-per-symbol rate being one of a power of two, a non-power of two and a non-integer.

49. A communication system communicating data bits through a data channel, comprising:

10 a data transformer coupled with the data channel, the data transformer transforming the data bits into a transmission symbol, the transmission symbol being composed of a selectable integer number of data bit vectors, each of the data bit vectors being composed of a selectable predetermined integer number of  
15 the data bits, the data transformer mapping a selectable number of transmission symbols into a data symbol selected from a signal constellation, the signal constellation being one of an integer signal constellation and a power-of-two signal constellation, the selectable predetermined integer number of data bits being  
20 selected to provide a preselected average data bit transmission rate.

50. The communication system of Claim 49, further comprising:

25 a controller coupled between the data channel and the data transformer, the controller sensing at least one data channel condition and compelling the data transformer to select one of the selectable integer number of data bit vectors and the selectable predetermined integer number of the data bits,  
30 responsive thereto.

51. The communication system of Claim 49, wherein the selectable predetermined number integer number of data bits is adaptively selected.

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52. The communication system of Claim 51, wherein the  
selectable predetermined integer number of data bits is one of  
5  $k$  bits and  $k+1$  bits, where  $k$  is an integer number of data bits.

53. The communication system of Claim 52, wherein the  
preselected average data bit transmission rate is a non-integer  
data bit transmission rate.

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54. A communication system, comprising:

- a. a constellation-multiplexing transmitter; and
- b. a maximum-likelihood sequence estimation receiver.

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55. The communication system of Claim 54, wherein the  
maximum-likelihood sequence estimation receiver selects a path  
through a code trellis having a substantially minimum noise-  
power-inversely-weighted-squared-Euclidean distance.

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